AMENDMENTS TO THE SPECIFICATION

Please amend the paragraphs starting at line 10 on page 1 as follows:

PWM (Pulse Width Modulation) techniques are frequently used in power electronics to drive large load currents because of their ~~its~~ high efficiency. In comparison, linear currents ~~current~~ are almost never used in driving large load currents because of their ~~its~~ poor efficiency. However, because there are no switching signals in a linear current source, the output current will not have any ripple. A PWM driven load current will inevitably experience some ripple, the amplitude dependent on the cutoff frequency and attenuation of the filtering network.

Four power MOSFETs (Metal Oxide Semiconductor Field Effect Transistor) connected in an H-bridge are ~~is~~ commonly used to drive a differential load. Figures 1 and 2 depict conventional H-Bridge circuits 10 used to drive a load. The H-Bridge circuit depicted in the figures includes four switches (12[[.]], 14, 16 and 18) arranged as shown to drive a load 19, as is well understood in the art.

Figure 1 depicts current flowing from left to right, and shall be defined herein as "cooling". Figure 2 depicts current flowing from right to left and shall be defined herein as "heating". Figures 1 and 2 show ~~shows~~ the signals required to drive 4 H-bridge connected power MOSFETs ~~MOSFET~~ to drive a resistive load in the heating and cooling mode. For example, to drive the load in the cooling mode (Figure 1), PWM signals are applied to P1 and N1. ~~Whereas~~ P2 is disabled ~~disable~~ and N1 is fully turned on. This operation is similar to a buck converter, as is known in the art. The duty cycle of the PWM signal will control the current flowing to the resistive load. Filter elements L1, C1, L2 and C2 will attenuate the ripple current though the load. Filter elements L1, C1, L2 and C2 will attenuate the ripple current through the load. Each switch has an associated pre-driver circuit (not shown) that drivers the switch at an appropriate level.

Such a design will experience some problems when small current is required through the load. At small load current, the duty cycle of the PWM signals is ~~are~~ correspondingly reduced.

However, the driving capability of pre-divers circuits is limited in terms of duty cycle. Moreover, the gate capacitance of power MOFSETs are quite significant. Hence, it is not possible to drive the MOFSETs at very small duty cycle. Moreover, the gate capacitances of the power MOFSETs are quite significant. Hence, it is not possible to drive the power MOFSETs at very small duty cycle resulting in the system not being able to output small load current in either the heating or cooling mode. Likewise, the percentage of ripple current will increase significantly as the average DC value of the load current decreases.

Figures 3 and 4 show another variation of Figures 1 and 2 in which one set of the filter elements, L2 and C2, is ~~are~~ removed. This generally results in costs saving and a smaller form factor. However, the circuit 20 of Figures 3 and 4 still suffers from the same deficiencies as ~~of~~ the circuit of Figure 1 and 2, i.e., increased ripple at low current conditions.

Please amend the paragraphs starting at line 19 on page 2 as follows:

In one aspect, the present invention provides an H-Bridge load driving circuit, comprising four power switches forming an H-Bridge circuit selectively coupled to a load supply current to the ~~said~~ load; and at least one current source; ~~wherein said~~ the circuit being adapted to couple the ~~said~~ power switches or the ~~said~~ current source to the ~~said~~ load as a function of load current.

In another aspect, the present invention provides a differential load driving circuit comprising: a plurality of power switches selectively coupled to a load to supply current to the ~~said~~ load; a plurality of power switch driving circuits operable to control the conduction state of the ~~said~~ power switches and to selectively couple at least one of the ~~said~~ plurality of power switches to a PWM signal; and at least one current source. The current source is coupled to the ~~said~~ load to deliver current to the ~~said~~ load during low current conditions at the ~~said~~ load, and said PWM signal is coupled to the ~~said~~ load to deliver current to the ~~said~~ load during high current conditions at the ~~said~~ load.

In another aspect, the present invention provides an H-Bridge load driving circuit, comprising four power switches forming an H-Bridge circuit selectively coupled to a load to supply current to the ~~said~~ load; a plurality of power switch driving circuits operable to control the conduction state of the ~~said~~ power switches and to selectively couple at least two of the ~~said~~ plurality of power switches to a PWM signal; and at least one current source. The H-Bridge circuit has ~~having~~ a first mode in which the ~~said~~ current source is coupled to the ~~said~~ load to supply current to the ~~said~~ load and a second mode in which at least two of the ~~said~~ power switches are coupled to the ~~said~~ PWM signal to supply current to the ~~said~~ load.

In yet another aspect, the present invention provides a differential driving circuit for driving a thermal electric cooler, the ~~said~~ circuit comprising: a plurality of power switches selectively coupled to a thermal electric cooler load to supply current to the ~~said~~ load; a plurality of power switch driving circuits operable to control the conduction state of the ~~said~~ power switches and to selectively couple at least one of the ~~said~~ plurality of power switches to a PWM signal; and at least one current source. The differential driving circuit has ~~having~~ a first mode in which the ~~said~~ current source is coupled to the ~~said~~ load to supply current to the ~~said~~ load and a second mode in which at least two of the ~~said~~ power switches are coupled to the ~~said~~ PWM signal to supply current to the ~~said~~ load.

Please amend the paragraph starting at line 20 on page 5 as follows:

In the following Detailed Description, the load 19 may include a Thermal Electrical Cooler (TEC). Such a device is operable in heating and cooling modes, depending on the direction of current flow. A TEC is used as a heating/cooling component to control precise temperature of devices, especially in Optical communication devices. When positive current passes through a TEC, the TEC will the heat device with precise temperature requirement, and when negative current passes through the TEC, it will cool the device. However, the present invention is not intended to be limited by such a load or to any type of load.

Please amend the paragraph starting at line 19 on page 8 as follows:

In applications where only small heating current is required, the embodiments ~~embodiment~~ of ~~Figure~~ Figures 5-8 can be modified to reduce the number of reactive components by removing an ~~and~~ LC set as depicted in the circuit 100 of Figure 10. Figure 10 is one exemplary circuit diagram of an H-Bridge load driver operating in a PWM heating mode according to a second embodiment of the present invention. Operation of the circuit 100 in low current linear heating mode is similar to the description above of Figures 5-8, and includes coupling current source 106 (via switch 108) to the load 19. In this embodiment, the switch driving circuits 102 and 104 are similar to switch driving circuits 52 and 56 of Figures 5-8. Switch P2 includes switch driving circuit 110. The current source in this case would be the external power PMOS P2 biased by the output of an OTA (output transconductance amplifier). A similar circuit can be constructed along these principles for small cooling current applications.

Please amend the paragraph starting at line 14 on page 9 as follows:

In the embodiments ~~this embodiment~~ of Figures 11-14, an LC filter set is eliminated. Unlike the previous embodiments ~~embodiment~~, however, these embodiments are ~~this embodiment is~~ capable of delivering larger heating and cooling current. Figure 11 is one exemplary circuit diagram of an H-Bridge load driver circuit 200 operating in a linear cooling mode according to a third embodiment of the present invention. In this embodiment 2 current sources ~~are used~~ 210 and 212 are used. Current source 210 is a source and current source 212 operates to sink current. When operating in the linear, cooling mode as shown in Figure 11, current source 210 is coupled to the load (via switch 214), N2 ~~has~~ is fully turned on and P2 is fully turned off. P1 and N1 are disabled. Switching circuits 202, 204, 206 and 208 couple the power MOSFETs to the appropriate source as shown in Figures 11-14 (i.e., to the PWM signal, VCC or ground).

AMENDMENTS TO THE FIGURES

Attached are replacement sheets for Figure 5, 6, 7 and 8 and annotated versions showing the changes made to Figures 5, 6 and 7.